ESSO TUTU SERVICE STATION

SOIL GAS VAPOR SCREENING SURVEY REPORT

ST. THOMAS, U.S.V.I.

JUNE 14, 1988

PREPARED FOR

ESSO STANDARD OIL S.A. LTD.

PREPARED BY

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1.0 PROJECT SUMMARY

On June 8, 1987, the reporting of the presence of chemicals in one of the water wells in the Tutu area of St. Thomas, US Virgin Islands (USVI) prompted the Department of Planning and Natural Resources (DPNR) of the USVI and the US Environmental Protection Agency Region II to conduct a sampling investigation of all the production wells in the area. Sample analyses revealed the presence of chlorinated & aromatic hydrocarbons, among other chemicals, in the water of some of the Tutu area wells. The highest concentration of dissolved volatile organic compounds was reported to be found at the Tillet Garden well located approx. 300 ft. upgradient from the Esso Tutu Service Station (ETSS).

Because of the reported presence of aromatic hydrocarbons, DPNR/EPA issued Administrative Orders to two of the service stations in operation in the immediate vicinity (eg. Esso and Texaco). This administrative order required the preparation and submittal of a Work Plan designed to investigate possible product releases.

In September, 1987, Esso Standard Oil S.A. Ltd. (ESSO) retained Belgodere & Associates, Inc. (BAI) to prepare the required soil vapor sampling plan for the Esso Tutu Service Station. After on-site evaluations and discussions between DPNR/EPA, Camp, Dresser & McKee (CDM, EPA's Contractor), BAI and ESSO, the Work Plan for this investigation was drafted and approved on March 17, 1988. On April 5, 1988 BAI personnel

began the soil vapor screening survey. The initial screening investigation was completed on April 23, 1988.

The survey results show an area of hydrocarbon vapor concentrations with levels ranging from not detectable (ND) to 1,675 ppm of benzene in the south and central portion of the ETSS facility. Immediately to the south of the ETSS property the vapor concentrations were significantly reduced. A second area of hydrocarbon vapor concentration ranging ND to 128 ppm of benzene was obtained offsite in an area adjacent to the west and southwest of the station. A third area of hydrocarbon vapor concentrations ranging from ND to 2.5 ppm of benzene was found throughout the remaining sampling stations.

Although chlorinated compounds are not associated with motor fuel storage and dispensing operations, DPNR-EPA requested ESSO to include in the soil vapor screening survey analyses of the following chlorinated hydrocarbons: dichloroethylene (DCE), tetrachloroethylene (PCE), trichloroethylene (TCE). This request was made by the agencies because chlorinated compounds were reported in the groundwater, and found in a previous soil vapor survey conducted in the area. This investigation showed that chlorinated hydrocarbon vapors were present in most of the points sampled.

A soil vapor survey was conducted at the Texaco service station. The Texaco service station is located 600 ft. upgradient from the ETSS facility. A report of their finding was submitted on December 18, 1987, to the regulatory agencies.

2.0 PROJECT BACKGROUND

A number of water wells have been shut down by the Department of Planning and Natural Resources of the USVI (DPNR) and the Environmental Protection Agency Region II, New York (EPA) as a result of reported groundwater contamination in the Tutu area of St. Thomas, USVI. DPNR/EPA believe that among the possible sources of aromatic hydrocarbons found in the groundwater may be the gasoline stations which operate or had operated in the Tutu area. Esso, as the owner of a gasoline service station located in the Four Winds Shopping Center at the Tutu Area of St. Thomas, was issued an administrative order by DPNR to investigate the site. Esso contracted BAI to conduct the investigation and to issue a report on the findings.

ESSO and BAI representatives met several times with EPA's Project Managers, Mr. Charles Dolan, who was subsequently replaced by Ms. Caroline Kwan; DPNR's representatives, Ms. Francine Lang and Gregory Rhymer; and the Project Officer from Camp, Dresser & McKee Federal Programs Corporation (CDM-FPC), Mr. Scott B. Graber, to discuss the technical approach to be used in the investigation.

The initial proposed work plan submitted by ESSO to DPNR-EPA in September 1987 included drilling, collection and analyses of soil samples, installation of monitoring wells and the collection and analyses of groundwater samples.

DPNR-EPA rejected ESSO's original proposed investigation plan and suggested that a soil vapor screening survey be

performed. ESSO presumes that the findings of the soil vapor survey conducted at the ETSS site will be compared to the results of the soil vapor survey previously conducted to the north around the Texaco facility.

A second work plan was submitted and reviewed by DPNR/EPA. Approval of the plan was obtained on March 17, 1988. The soil vapor screening survey started on April 5 with DPNR/EPA understanding of the project limitations caused by the unavailability of low end BTEX standards of 1, 10, 100 ppb.

2.1 LOCATION AND PURPOSE OF STUDY

The Esso Tutu service station is located in St. Thomas USVI on the west side of road No. 38 in the Tutu area, at the south eastern corner of the Four Winds Shopping Center parking lot (see figure 2.1.1). Nearby facilities include a Texaco gasoline station (600' NNE), the LAGA building (formerly a clothing manufacturing plant, 875' NE), the Four Winds Shopping Center (75' W), Vitelco building (local telephone company, 100' E), Mike's Paint Store (250' ENE) and a private Lutheran school (400' S) (see figure 2.1.2).

From April 5 through 23, 1988, BAI personnel conducted a soil vapor screening survey in and around the Esso Tutu Service Station. The purpose of the soil vapor screening survey was to determine the presence and areal extent of hydrocarbon vapors in the soil matrix. It should be pointed out that soil vapor values cannot be directly equated to concentrations of dissolved hydrocarbons in the ground water.

2.2 HYDROGEOLOGICAL SETTING

According to information obtained from "Soil Survey of the U.S. Virgin Islands, 1970 Soil Conservation Service Report", issued in August 1970, the area is described as a network of terraces and alluvial fans sloping gently to moderately toward the south. Soil deposits consist of stratified sands, gravels

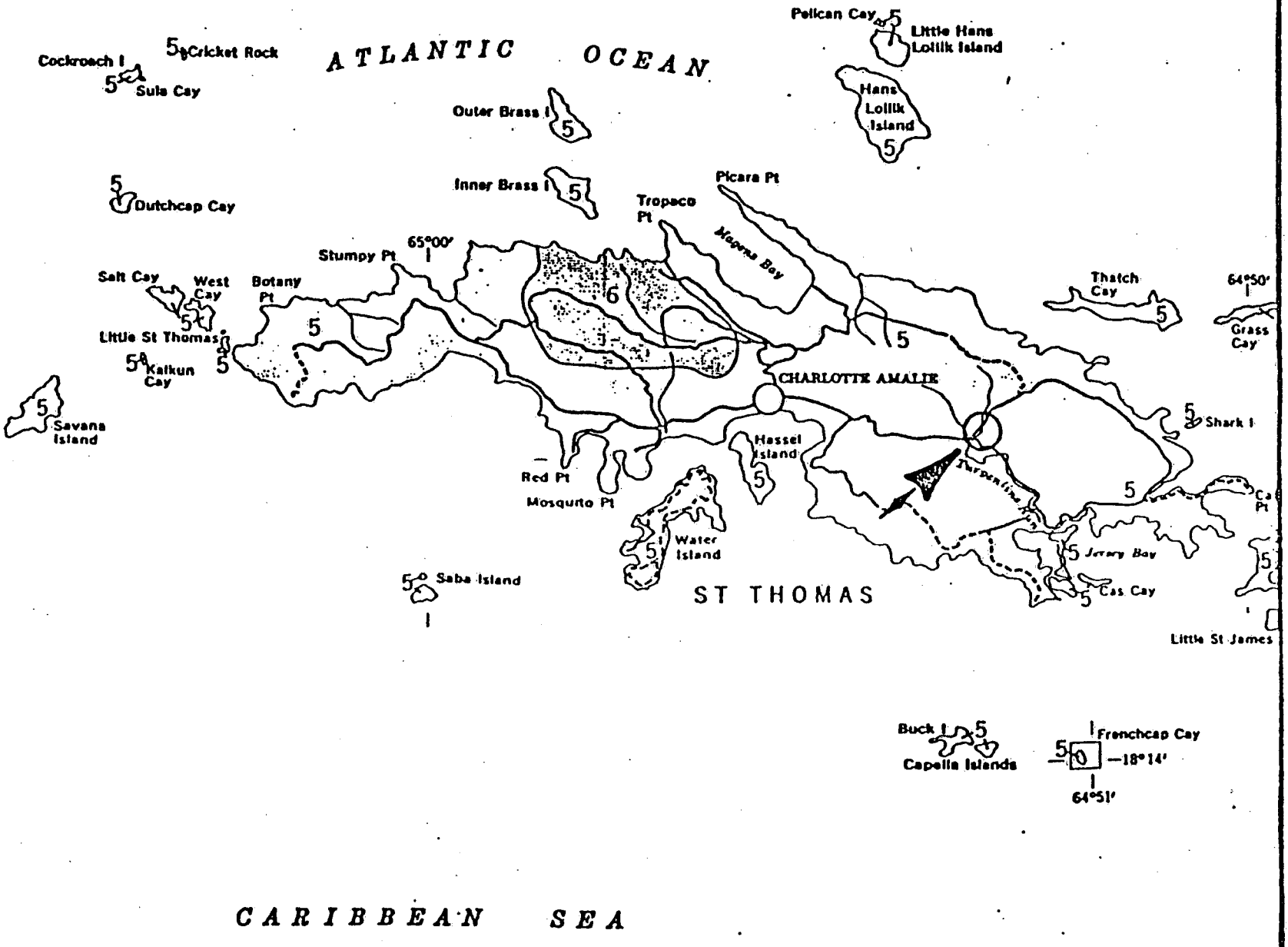

FIGURE 2.1.1

SITE LOCATION

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ENVIRONMENTAL—GEO CONSULTANTS

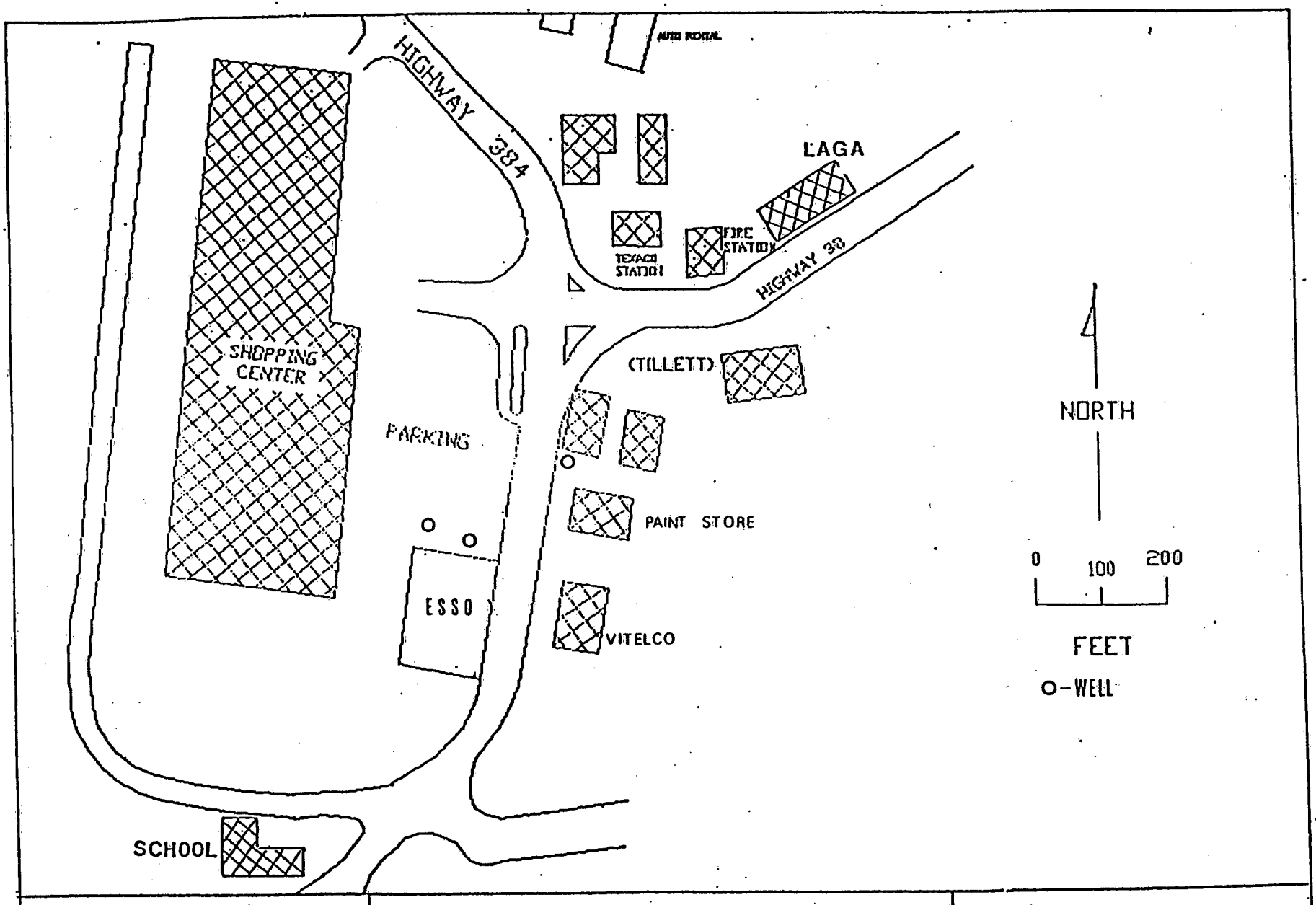


FIGURE 2.1.2

MAP OF CENTRAL TUTU AREA

BELGODERE & ASSOCIATES

ENVIRONMENTAL-GEO CONSULTANTS

and clays with a permeability of 0.20 to 0.63 in./hr. Soil strata thickness around the site location varies from exposed bed rock on side of hills to over 20 ft. in alluvial deposits.

Based on topographic and structural information obtained from "Geology of St. Thomas and St. John, U.S. Virgin Islands" by Thomas W. Donnelly (NSF, G-114407), the bedrock in the upper turpentine run basin is the Louisenhoj formation. Extensive deformation and fracturing has occurred due to later tectonic activities. Local groundwater flow in these rocks is controlled by fractures underlying the site area. The regional direction of groundwater flow is generally to the south.

Based on discussions with local water well driller (Poly Caribe), depth of groundwater at the Four Winds Shopping Center well (located 25 ft. north of the Service Station) and the Tillett Water Well (located 250 ft. to the northeast), is reported to be between 15 and 20 ft. during the rainy seasons when the water table is high and pumping of commercial and residential water wells is low. The local water table has been previously observed to drop below 90 ft. as a result of high water extraction during extended drought periods (see table 2.2.1). Water supply wells in the vicinity are generally drilled to depths between 100 to 200 ft. below land surface.

Table 2.2.I

Well 21 (20-64.53-15-58)

Owner.--J. Tillet.
Location.--Lat 18° 20' 29", long 64° 53' 16".
Description.--Drilled water-table production well, diam 6-in, cased 0-15.
Depth.--100 ft.
Aquifer.--Volcanic rocks of Cretaceous age.
Measuring point.--Top of 6-in casing, 1.5 ft above lsd.

Land elevation.--200 ft above msl.
Highest water level.--38.40 ft below lsd, Jan. 2, 1964.
Lowest water level.--94.18 ft below lsd, July 5, 1968.
Records available.--Chemical analyses: 1963-68.
Water levels: 1964-68.
Remarks.--Measurement discontinued, April 1969.

CHEMICAL ANALYSIS

Milligrams per liter

Date of collection	Discharge (gpm)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Orthophosphate (PO_4)	Dissolved solids calculated	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Temperature (°C)	Footnote
Oct. 8, 1963	--	39	0.00	--	30	52	266	680	0	32	185	1.1	16	--	*888	289	0	1,535	7.9	28	--
May 13, 1964	--	39	.00	--	62	48	246	698	0	38	178	1.0	26	--	*1,060	352	0	1,680	7.7	28	--
May 26	--	44	.00	--	60	44	247	694	0	26	165	1.0	9	--	*967	330	0	1,650	8.0	--	--
June 25	--	43	.00	--	58	46	244	698	0	26	180	1.0	10	--	*965	334	0	1,650	7.9	28	--
Aug. 25	--	38	.00	--	60	48	247	702	0	28	190	.7	13	--	*953	347	0	1,650	8.2	28	--
July 25, 1966	--	41	.00	0.00	62	49	250	712	0	30	192	.8	16	--	*1,070	356	0	1,730	8.0	--	--
May 19, 1967	--	38	.06	.00	56	51	269	712	0	39	205	.8	23	--	*1,050	349	0	1,750	7.7	--	--
Sept. 1	--	39	.00	.00	56	46	268	716	0	38	195	.6	11	--	*1,060	328	0	1,720	8.0	31	--
Jan. 4, 1968	--	43	.02	.00	68	64	259	822	0	27	195	1.0	23	--	*1,060	435	0	1,760	7.7	27	--
Apr. 3	--	43	.00	.00	50	39	302 1.5	720	0	48	210	.8	22	0.0	1,070	286	0	1,750	8.1	26	--
May 15	--	45	.00	.00	60	60	267 1.5	756	0	45	192	1.3	26	.3	1,070	395	0	1,780	7.9	--	--
Dec. 4	--	41	--	.00	39	52	298 2.0	696	0	40	217	.7	44	.0	1,080	312	0	1,820	8.1	--	--

* Residue on evaporation at 180° C.

Water levels, in feet below land surface

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 2, 1964	38.40	Sept. 29, 1964	47.80	June 14, 1965	a71.67	Oct. 31, 1966	51.23
Jan. 23	39.08	Oct. 13	48.49	June 21	a71.61	Nov. 29	51.10
Feb. 3	39.40	Oct. 19	49.00	June 29	a70.31	Dec. 28	a54.50
Feb. 10	39.52	Oct. 24	a51.22	July 7	a72.50	Jan. 31, 1967	55.35
Feb. 17	39.58	Nov. 2	49.39	July 21	68.60	Mar. 14	58.62
Mar. 5	40.02	Nov. 9	49.81	Aug. 5	68.69	Apr. 18	a65.82
Mar. 9	40.23	Nov. 23	49.80	Aug. 21	69.55	June 1	a66.94
Mar. 16	40.37	Nov. 30	50.40	Aug. 31	68.50	July 6	67.75
Mar. 24	40.65	Dec. 7	a53.16	Sept. 30	66.25	Aug. 1	a72.07
Mar. 30	41.00	Dec. 14	a54.40	Oct. 29	a65.48	Sept. 1	a75.87
Apr. 7	41.01	Dec. 21	52.29	Nov. 12	a58.09	Oct. 3	81.61
Apr. 13	41.10	Dec. 28	a53.29	Nov. 26	55.75	Nov. 1	a86.10
Apr. 20	41.32	Jan. 4, 1965	a56.30	Dec. 8	54.05	Dec. 5	a85.78
May 5	41.67	Jan. 11	a56.93	Dec. 14	47.28	Dec. 7	a85.67
May 11	41.96	Jan. 26	55.16	Dec. 27	42.45	Jan. 4, 1968	a85.72
May 13	42.05	Feb. 8	56.56	Jan. 3, 1966	42.27	Jan. 22	82.69
May 18	a45.60	Feb. 15	57.59	Jan. 17	40.61	Mar. 5	92.26
May 26	44.35	Feb. 23	a58.63	Jan. 27	40.42	Apr. 3	89.65
June 1	44.16	Mar. 2	60.81	Feb. 14	40.28	May 3	88.17
June 8	46.99	Mar. 8	61.85	Mar. 15	41.10	June 3	92.75
June 15	44.98	Mar. 15	66.10	Mar. 30	a42.28	July 5	94.18
June 22	47.02	Mar. 23	70.08	Apr. 12	42.51	Aug. 1	83.35
June 29	46.55	Mar. 30	a75.17	Apr. 26	42.79	Oct. 1	68.07
July 6	45.37	Apr. 6	75.61	May 10	43.14	Nov. 5	a75.10
July 13	45.28	Apr. 19	74.32	May 26	44.09	Dec. 4	66.13
July 20	45.52	Apr. 26	a81.62	June 8	45.40	Jan. 3, 1969	57.49
Aug. 10	46.40	May 3	75.59	June 27	46.50	Feb. 5	61.96
Aug. 24	46.94	May 15	71.68	July 11	49.83	Mar. 24	a58.94
Aug. 31	46.93	May 18	69.28	July 25	48.79	Apr. 23	57.55
Sept. 9	47.71	May 24	69.00	Aug. 5	49.75		
Sept. 14	48.19	June 2	67.31	Aug. 30	a52.34	a - pumping.	
Sept. 23	47.99	June 7	67.86	Sept. 27	50.93		

3.0 METHOD OF INVESTIGATION

A preliminary field and literature investigation was performed by BAI personnel during the months of September through December 1987 to allow for optimization of resources during soil vapor extraction and testing operations. The results of the preliminary site investigation were reported in section 3.4 of the Esso Tutu Service Station Soil Vapor Investigation Plan, dated January 11, 1988.

3.1 SOIL VAPOR SCREENING SURVEY

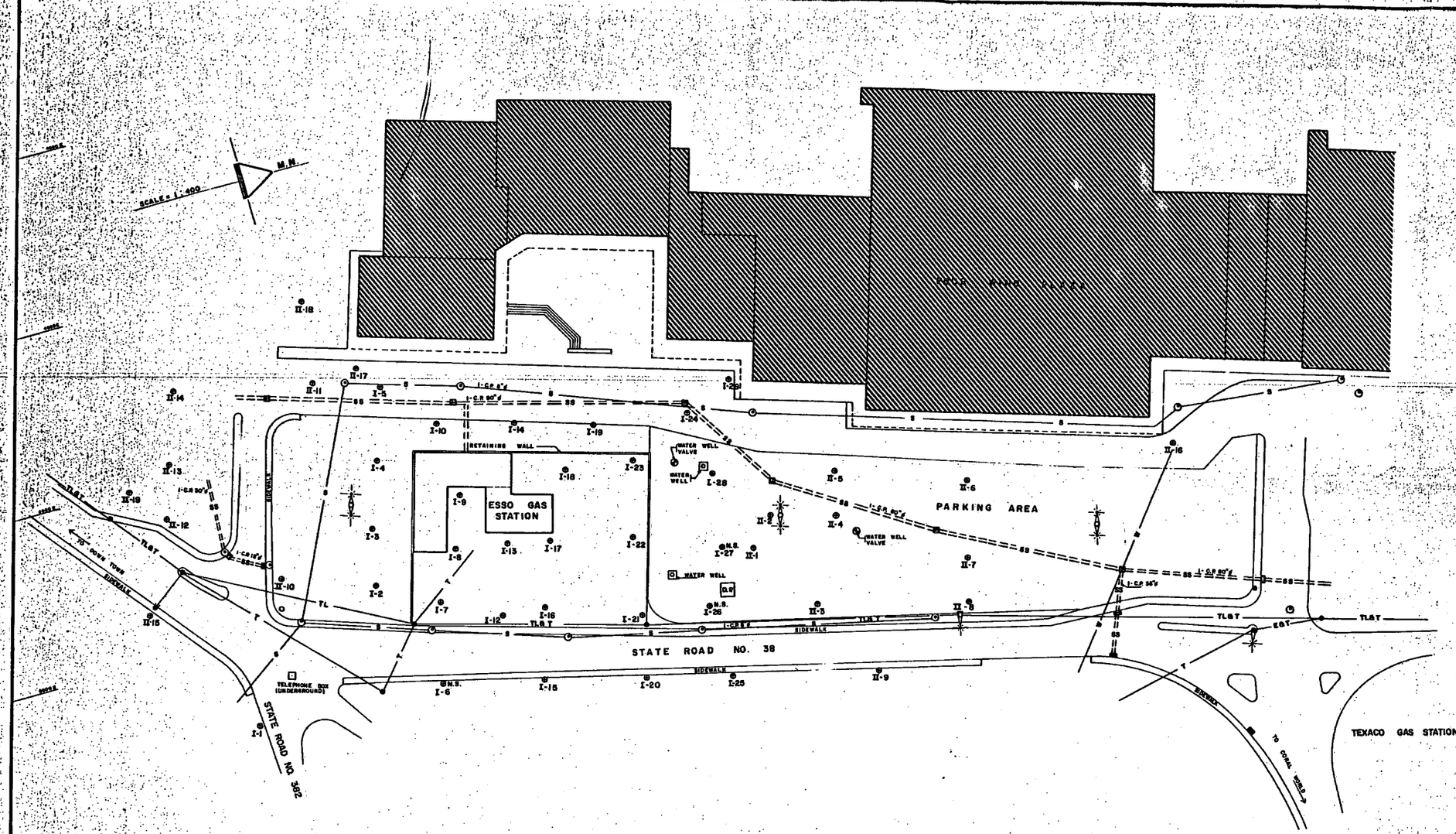
The soil vapor screening survey was conducted in and around the ETSS facility between April 5 and April 23, 1988. The screening survey consisted of obtaining soil vapor samples at different locations and depths, and performing on-site analyses of the samples using two HNU-301 gas chromatographs (GC) owned and operated by BAI.

Soil vapor sampling and field analyses were performed as outlined in the Esso Tutu Service Station Soil Vapor Investigation Plan and the Esso Tutu Service Station QA/QC Plan dated January 11, 1988 (second revision), with modifications based on field conditions and requests by DPNR/EPA/CDM.

The soil vapor sampling stations consisted of 11 points located inside the service station property and 33 points located outside the facility. Samples at each station were taken from depths between 2-4 ft. and 6-8 ft. where local conditions allowed. A sampling location map is presented in figure 3.1.1.

Soil vapor samples were collected by driving a 5/8 inch diameter hollow stainless steel probe to the appropriate depth by hand with a slide hammer. Once the desired depth was achieved, 5 to 10 liters of soil vapor from around the shield point were extracted with the use of a 1,700 cc/min battery operated vacuum pump (with built-in rotameter). The pump was attached to the probe with a tygon hose containing a septum sampling port and a vacuum gauge. Gas tight syringes were inserted through the septum port to collect two to four 2.5 milliliter to 25 microliter vapor samples for immediate on-site analysis.

Samples were analyzed for aromatic hydrocarbons (BTEX), which typically comprise the major constituents of commercial gasoline. Chlorinated hydrocarbons TCE, PCE, and DCE, although not typically found in gasoline were also analyzed.



LOCATION PLAN 1 : 20,000

BORING	COORDINATES Y	X
I - 1	4,984.7068	5,020.4167
I - 2	5,018.5645	4,996.1435
I - 3	5,021.1871	4,983.2743
I - 4	5,026.2624	4,988.4895
I - 5	5,031.3505	4,982.1880
I - 6	5,027.3351	5,021.5095
I - 7	5,051.6320	5,003.6019
I - 8	5,038.4968	4,997.5088
I - 9	5,042.2218	4,981.0661
I - 10	5,041.4478	4,983.7731
I - 11	N.S.	N.S.
I - 12	5,044.4321	5,010.7515
I - 13	5,049.8873	4,994.3805
I - 14	5,038.5229	4,988.0787
I - 15	5,049.7554	5,026.9379
I - 16	5,054.2353	5,010.7367
I - 17	5,049.3043	4,996.4100
I - 18	5,056.8174	4,981.3062
I - 19	5,073.7050	4,973.8811
I - 20	5,072.1790	5,032.8570
I - 21	5,074.8400	5,018.9570
I - 22	5,077.6499	5,000.4044
I - 23	5,082.0900	4,983.6048
I - 24	5,087.1410	4,978.2048
I - 25	5,091.0537	5,037.4676
I - 26	5,090.1850	5,020.4814
I - 27	5,096.5125	5,006.2314
I - 28	5,068.5016	4,990.9647
I - 29	5,108.6870	4,971.1858
II - 1	5,103.4396	5,010.1482
II - 2	5,108.9698	5,003.7722
II - 3	5,113.9905	5,026.3989
II - 4	5,123.3563	5,017.2476
II - 5	5,125.7058	4,987.8604
II - 6	5,154.2248	5,007.8975
II - 7	5,149.8078	5,025.0780
II - 8	5,147.4665	5,034.8980
II - 9	5,123.4471	5,044.7804
II - 10	4,996.2248	4,988.9306
II - 11	5017.2445	4,947.1530
II - 12	4,977.0877	4,968.5328
II - 13	4,980.8134	4,956.2407
II - 14	4,986.1960	4,940.9133
II - 15	4,967.5671	4,968.9789
II - 16	5,202.1863	5,012.1930
II - 17	5,027.3920	4,946.1142
II - 18	5,019.7036	4,928.4987
II - 19	4,970.4226	4,960.4761

LEGEND:

- TL — TRANSMISSION LINE
- T — TELEPHONE LINE
- E — ELECTRICAL LINE
- W — WATER LINE
- S — SANITARY LINE
- 30 — STORM SEWER LINE
- MANHOLE
- CATCH BASIN
- CREOSOTED POLE
- ORNAMENTAL POLE
- LUMINARY
- 50.001 — SPOT ELEVATIONS
- B.M. — BENCH MARK (SEE NOTE)
- N.S. — NOT SAMPLED
- N.D. — NOT DETECTED
- M.E. — MASKING EFFECT
- D — DCE
- T — TCE
- P — PCE

NOTES:

1- ALL DISTANCES AND ELEVATIONS ARE IN METERS.
2- HORIZONTAL AND VERTICAL CONTROL ARE REFERED TO LOCAL SYSTEM.
3- BENCH MARK- CHISELED TRIANGLE MARK ON MANHOLE FRAME. ELEV. = 50.000 MTS. (ASSUMED).

SAMPLING LOCATION MAP - FIGURE 3.1.1

PREPARED FOR : BELGODERE AND ASSOCIATES, INC.
LOCATION : FOUR WIND PLAZA SHOPPING CENTER
STATE ROAD NO. 38 ST. THOMAS, U.S. VIRGIN ISLAND

SURVEY CERTIFICATE:

I DO HEREBY CERTIFY THAT THIS SURVEY WAS MADE DURING THE MONTH OF APRIL 1988, THAT THEODOLITES FOR HIGH ORDER ACCURACY (WILD T-2), AND ELECTRONIC DISTANCE MEASURING INSTRUMENT (WILD DI-3) WERE USED FOLLOWING THE STANDARD SURVEY TECHNIQUES FOR THESE CASES.

KELLY ALVAREZ PEREZ AGRIMENSOR LICENCIADO LIC. 1178 PUERTO RICO

PRJ 88-22 (500)

a.d.a. ALVAREZ - DIAZ ASSOCIATES
engineers - land surveyors
500 BALEARES ST. PUERTO NUEVO P.R., GPO BOX 3785, SAN JUAN, PUERTO RICO 00936 - TEL. 783-6825

CERTIFIED BY: DATE:

Kelly Alvarez Perez B.S.L.S. LIC. NUM. 1178

Marcelino Diaz Declet B.S.L.S. LIC. NUM. 1188

As previously mentioned, two GC's were used for the field analyses. GC No. 1 was equipped with a photo ionization detector (PID) and a flame ionization detector (FID) and a 10% TCEP, Chromosorb PAW 8' x 1/8" ss pack column. GC No. 2 was equipped with a FID and a 3% SE 30 Chromosorb WAW 6' x 1/8" ss pack column. Both GC's were equipped with Spectra Physics model SP4290 integrators for data reduction.

Initially, GC No. 1 was set to selectively identify aromatic hydrocarbons and GC No. 2 to selectively identify chlorinated hydrocarbons. Due to constant voltage fluctuations ranging from 92 to 125 volts, and daily power outages during the first days of the investigation, the PID/FID GC and both integrators failed to perform as designed. The PID was affected by decreased sensitivity, and the integrators used to calculate peak areas were malfunctioning which required later manual data reduction.

The voltage irregularity was minimized by installing a Topaz model 02906-02P3 power conditioning unit. However, even with this unit, the voltage fluctuations damaged GC No. 1, and all the samples were subsequently analyzed using GC No. 2 only.

In an effort to eliminate voltage variations and power outages, an on-site generator (Onan 3.5 kw) was employed which produced a constant 145 volts until breakdown occurred after 5 days of use.

Analyses of the soil vapor samples showed that the range of concentrations were several orders of magnitude. Due to the range of results, and unavailability of the low end BTEX

standards, it was agreed by all representatives that sufficient information for the survey was obtained when the aromatic hydrocarbon vapor concentrations were below 1 ppm for each BTEX component. The sampling boundaries were thus finalized when sample results were below 1 ppm. This replaced the previous agreement that the soil vapor survey limits were reached when the concentrations were below three times background.

4.0 RESULTS OF SOIL GAS SURVEY

4.1 AROMATIC HYDROCARBONS

Table 4.1.1 presents the highest BTEX analyses results of the sequential samples obtained from each soil vapor sample point. Sequential samples were taken during the survey instead of duplicate split samples originally proposed in the Work Plan. Copies of all chromatograms and daily calibration curves are presented in a separate supplement entitled: "Photocopies of Original Gas Chromatograms and Calibration Curves".

During the previous study performed by Geoscience Consultants, Ltd. for Texaco, background concentration for the general area were found to be between 0.1 to 0.9 ppb of total petroleum hydrocarbons. At the drift point selected for the ETSS soil vapor investigation, repeated samples were taken by inserting separate probes within an area of less than 150 square feet to determine whether soil vapor values varied significantly over time and short distance (see tables 4.1.2A and 4.1.2B for results and figure 3.1.1 for location). Drift point Benzene values ranged between <1 ppm and 160 ppm. The highest value recorded was from a sample obtained from a depth of 8 ft., the deepest depth attained. The range of values obtained in the drift point area may be in part controlled by the inability to obtain samples from the same depth along with the time and spacial differences that could naturally occur. Depth achieved for any sampling point was controlled by local lithology.

Values reported in tables 4.1.1 and 5.0.1 are the calculated values without subtracting background and/or drift point values.

The soil vapor screening survey identified three areas of measurable BTEX vapor concentrations:

- Area 1 - Service station property and area south of property.
  Benzene vapor concentrations ranged from ND to 1,675 ppm.

- Area 2 - West and southwest of service station.
  Benzene vapor concentrations ranged from ND to 128 ppm.

- Area 3 - North and east of the service station.
  Benzene vapor concentrations ranged from ND to 2.5 ppm.

Figure 4.1.3 presents a distribution map of benzene vapor results found during this study.

TABLE 4.I.I.

HIGHEST CONCENTRATIONS OF AROMATIC HYDROCARBON VAPORS FOUND IN SOILS GAS SAMPLES, ESSO TUTU AREA (PPM)

LOCATION	DATE	DEPTH	BENZENE	TOLUENE	XYLENE
I-1	APRIL/20	3'10"	ND	0.722	ND
I-2	APRIL/06	2'6"	ND	ND	ND
I-3	APRIL/06	1'6"	ND	ND	ND
I-4	APRIL/22	3'0"	24.68	ND	3.295
I-5	APRIL/20	3'0"	0.223	3.277	0.011
I-7	APRIL/07	2'4"	40.55	ND	17.81
I-8	APRIL/07	4'0"	1137.593	ND	29.1
I-8	APRIL/07	8'0"	1268.772	ND	445.1
I-9	APRIL/11	4'8"	977.536	296.955	54.559
I-10	APRIL/11	2'3"	128.630	44.196	10.876
I-12	APRIL/07	3'6"	2.353	ND	349.1
I-13	APRIL/07	4'0"	ND	ND	ND
I-14	APRIL/11	3'6"	70.6	11.32	ND
I-15	APRIL/15	3'6"	ND	0.249	0.098
I-16	APRIL/23	2'3"	0.102	0.391	ND
I-17	APRIL/22	4'0"	1675.18	80.45	83.92
I-18	APRIL/12	2'10"	ND	0.011	ND
I-19	APRIL/11	7'5"	ND	ND	ND
I-20	APRIL/16	2'4"	0.116	0.522	3.922
I-21	APRIL/12	4'6"	0.004	ND	ND
I-22	APRIL/12	3'0"	135.8	10.58	ND

CONT.

I-23	APRIL/12	4'0"	6.11	ND	ND
I-24	APRIL/14	2'8"	0.042	0.418	1.37
I-25	APRIL/20	3'0"	ND	0.173	0.003
I-28	APRIL/13	4'6"	0.057	0.015	0.465
I-29	APRIL/13	4'8"	ME	ME	ME
II-1	APRIL/16	1'11"	0.763	0.012	0.021
II-2	APRIL/16	2'2"	2.598	0.174	0.199
II-3	APRIL/16	2'3"	ND	0.144	0.418
II-4	APRIL/18	4'0"	ND	0.135	0.132
II-5	APRIL/19	1'8"	0.009	1.86	0.001
II-6	APRIL/19	2'4"	0.052	2.75	3.924
II-7	APRIL/19	3'9"	0.024	1.64	ND
II-8	APRIL/19	5'6"	ND	0.745	0.003
II-9	APRIL/19	3'0"	0.030	0.688	ND
II-10	APRIL/20	2'0"	0.235	5.847	0.012
II-11	APRIL/21	2'4"	ND	15.03	1.30
II-12	APRIL/21	2'9"	ND	0.018	0.067
II-13	APRIL/21	3'0"	0.286	3.987	0.005
II-14	APRIL/21	3'0"	0.081	1.79	0.066
II-15	APRIL/21	3'0"	0.013	0.014	0.056
II-16	APRIL/22	3'0"	0.050	0.833	0.481
II-17	APRIL/22	2'6"	0.109	0.131	0.033
II-18	APRIL/22	2'2"	ND	1.21	ND
II-19	APRIL/23	2'9"	0.016	1.184	0.925

ME-Masking Effect

ND-Not Detected

Table 4.1.2 A

VALUES SHOWING

HIGHEST CONCENTRATION OF AROMATIC HYDROCARBON VAPORS,

ESSO TUTU AREA (PPM)

LOCATION	DATE	DEPTH	BENZENE	TOLUENE	M-P-XYLENE	O-XYLENE
D.P.1	4/6/88	8'0"	ND	ND	ND	ND
D.P.2	4/7/88	6'0"	160.679	ND	ND	ND
D.P.3	4/8/88	3'6"	ND	ND	ND	ND
D.P.4	4/11/88	6'8"	ND	ND	ND	ND
D.P.5	4/12/88	6'0"	ME	ND	ND.	ND
D.P.6	4/13/88	7'0"	ND	0.660	ND	5.880
D.P.7	4/14/88	6'3.5"	ND	0.964	0.984	0.330

ME MASKING EFFECT

ND NOT DETECTED

Table 4.1.2 B

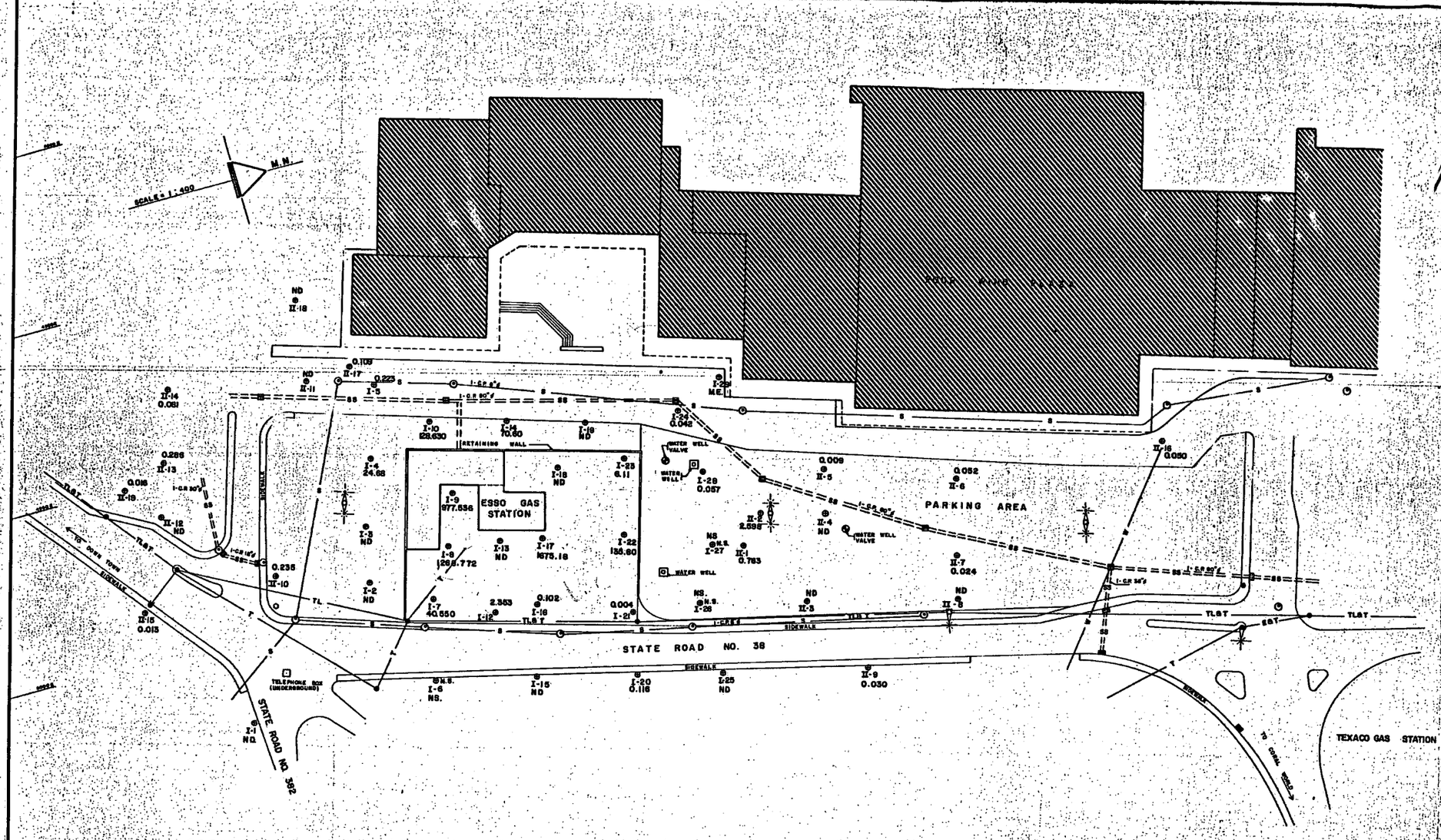
VALUES SHOWING

HIGHEST CONCENTRATION OF CHLORINATED HYDROCARBON VAPORS,

ESSO TUTU AREA (PPM)

LOCATION	DATE	DEPTH	DCE	TCE	PCE
D.P.1	4/6/88	8'0"	ND	ND	ND
D.P.2	4/7/88	6'0"	ND	ND	ND
D.P.3	4/8/88	3'6"	ND	ND	ND
D.P.4	4/11/88	6'8"	ND	ND	ND
D.P.5	4/12/88	6'0"	ND	ND	3.064
D.P.6	4/13/88	7'0"	ND	ND	ND
D.P.7	4/13/88	6'3.5"	22.16	0.104	0.196

ND NOT DETECTED



LOCATION PLAN 1: 20,000

BORING	COORDINATES Y	X
I - 1	4,984.7068	5,020.4457
I - 2	5,018.5645	4,998.1435
I - 3	5021. 1871	4,983.2768
I - 4	5,026.2824	4,968.4405
I - 5	5,031.3505	4,982.1800
I - 6	5,027.3381	5,021.9065
I - 7	5,031.6320	5,003.6018
I - 8	5,036.4868	4,992.5085
I - 9	5,042.2215	4,981.0681
I - 10	5041. 4618	4,963.7731
I - 11	N.S.	N.S.
I - 12	5,044.4521	5,010.1378
I - 13	5,049.8873	4,994.3608
I - 14	5,056.3229	4,981.0181
I - 15	5,049.7956	5,026.9378
I - 16	5,054.2593	5,010.7298
I - 17	5,059.3043	4,996.4408
I - 18	5,066.8174	4,981.9062
I - 19	5,075.7053	4,973.1911
I - 20	5,072.1790	5,032.2870
I - 21	5,074.9409	5,018.3510
I - 22	5,077.6499	5,000.4244
I - 23	5,082.0908	4,985.8048
I - 24	5,087.1410	4,976.2043
I - 25	5,061.2527	5,037.4676
I - 26	5,090.1850	5,020.4814
I - 27	5,095.8125	3,998.1234
I - 28	5,088.5018	4,980.8642
I - 29	5,108.6870	4,971.1868
II - 1	5,103.4396	5,010.1462
II - 2	5,108.9698	5,003.7723
II - 3	5,113.9805	5,026.3896
II - 4	5,123.3963	5002.8478
II - 5	5,125.7058	4,987.8604
II - 6	5,134.2248	5,027.8975
II - 7	5,148.8078	5,025.0740
II - 8	5,147.4685	5,054.8980
II - 9	5,123.4471	5,044.7806
II - 10	4,998.2248	4,988.9308
II - 11	5017. 2445	4,967.1830
II - 12	4,977.0877	4,968.5328
II - 13	4,980.8134	4,988.5407
II - 14	4,986.1960	4,949.5133
II - 15	4,967.5671	4,988.9789
II - 16	5,202.1883	5012.1830
II - 17	5,027.3920	4,944.1148
II - 18	5,019.7036	4,928.4987
II - 19	4,970.4226	4,960.4781

LEGEND:

- TL — TRANSMISSION LINE
- T — TELEPHONE LINE
- E — ELECTRICAL LINE
- W — WATER LINE
- S — SANITARY LINE
- SD — STORM SEWER LINE
- MANHOLE
- CATCH BASIN
- CREOSOTED POLE
- ORNAMENTAL POLE
- LUMINARY
- SPOT ELEVATIONS
- B.M. — BENCH MARK (SEE NOTE)
- N.S. — NOT SAMPLED
- N.D. — NOT DETECTED
- M.E. — MASKING EFFECT
- O — OCE
- T — TCE
- P — PCE

NOTES:

1- ALL DISTANCES AND ELEVATIONS ARE IN METERS.
2- HORIZONTAL AND VERTICAL CONTROL ARE REFERED TO LOCAL SYSTEM.
3- BENCH MARK - CHISELED TRIANGLE MARK ON MANHOLE FRAME. ELEV. = 50.000 MTS. (ASSUMED).

DISTRIBUTION MAP OF BENZENE (PPM) FIGURE 4.1.3

PREPARED FOR : BELGODERE AND ASSOCIATES, INC.
LOCATION : FOUR WIND PLAZA SHOPPING CENTER
STATE ROAD NO. 38 ST. THOMAS, U.S. VIRGIN ISLAND

SURVEY CERTIFICATE:

I DO HEREBY CERTIFY THAT THIS SURVEY WAS MADE DURING THE MONTH OF APRIL 1988, THAT THEODOLITES FOR HIGH ORDER ACCURACY (WILD T-2), AND ELECTRONIC DISTANCE MEASURING INSTRUMENT (WILD DI-3) WERE USED FOLLOWING THE STANDARD SURVEY TECHNIQUES FOR THESE CASES.

PRJ88-22 (500)

KELLY ALVAREZ PEREZ AGRIMENSOR LICENCIADO LIC. 2178 PUERTO RICO

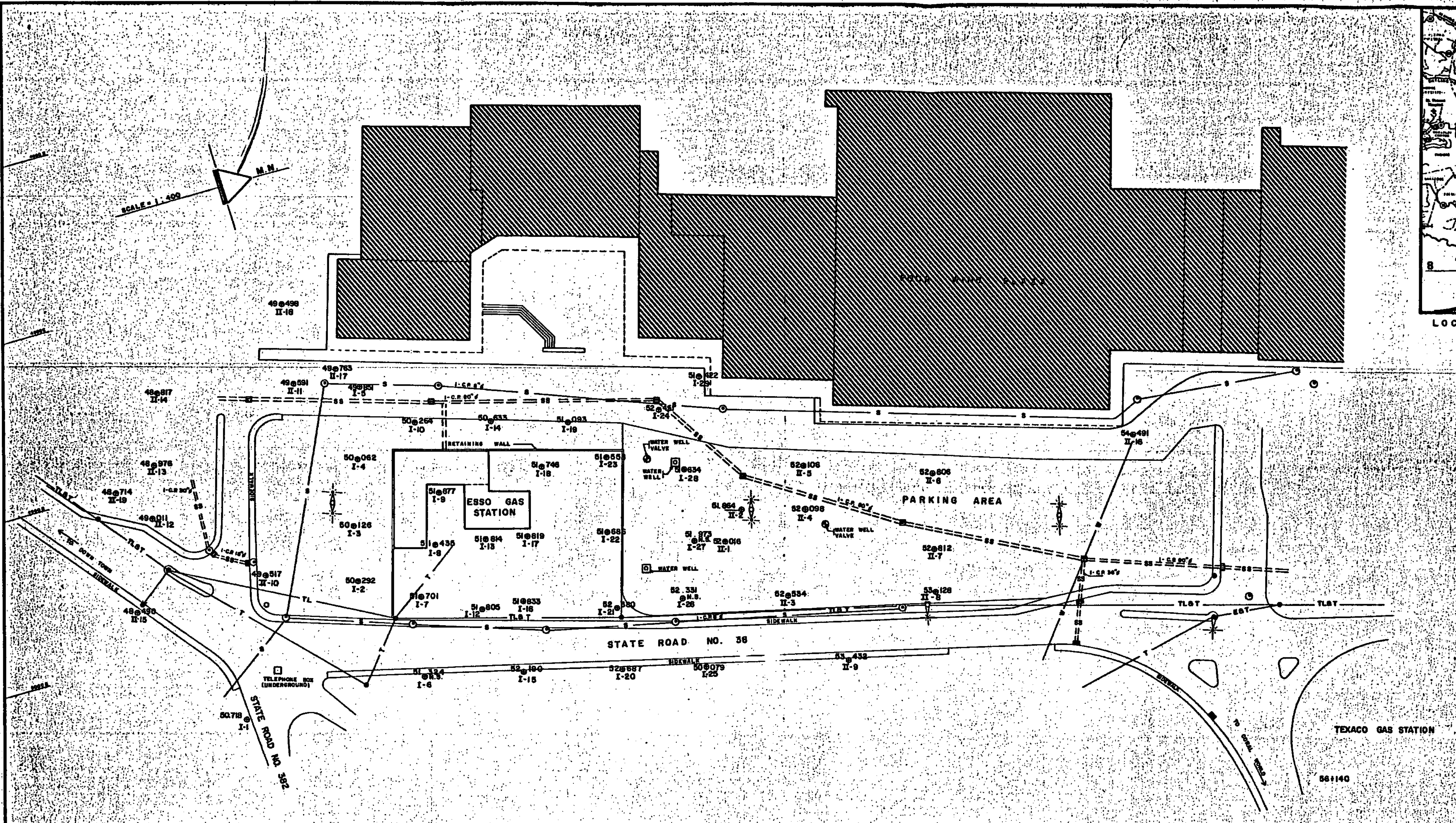
a.d.a. ALVAREZ - DIAZ ASSOCIATES
engineers - land surveyors
500 BALEARES ST. PUERTO NUEVO P.R., GPO BOX 3783, SAN JUAN PUERTO RICO 00936 - TEL. 783-6825

CERTIFIED BY: DATE: 5 / 7 / 88
Kelly Alvarez Perez B.S.L.S. LIC. NUM. 2178
Marcelino Diaz Declet B.S.L.S. LIC. NUM. 7186

4.2 **AREA 1** - ETSS facility and area south of the property.

The survey results show hydrocarbon vapor concentrations ranges from ND to 1,675 ppm of benzene. The highest concentrations were found in the south and central portion of the service station. Due to the variable depth to bedrock at the site, sampling at two different depths at the same location was not always possible.

The service station contains fill material surrounded by retaining walls. The retaining walls comprise the facility boundaries. Land surface elevation measurements (see figure 4.2.1) indicate an average height differential of approximately 5 ft. between the service station underground storage tanks area and the south portion of the shopping center parking lot adjacent to the facility. Two sample stations I-2 and I-3 immediately south of the facility tank field showed nondetectable levels of aromatic hydrocarbon vapors. However, at sample station I-4 located south of the western section of the ETSS property, the benzene vapor concentration was 24 ppm. Sample stations further south show significantly reduced levels of benzene vapor concentrations (see figure 4.1.3 for values).



LOCATION PLAN 1 : 20,000

BORING	COORDINATES	
	Y	X
I - 1	4,984.7068	5,020.4167
I - 2	5,018.5645	4,996.1435
I - 3	5,021.1671	4,983.2745
I - 4	5,026.2624	4,968.4895
I - 5	5,031.3505	4,982.1880
I - 6	5,027.3351	5,021.9095
I - 7	5,031.6320	5,003.6019
I - 8	5,038.4968	4,992.5085
I - 9	5,042.2215	4,981.0681
I - 10	5,041.4618	4,963.7731
I - 11	N.S.	N.S.
I - 12	5,044.4327	5,010.1316
I - 13	5,049.8873	4,994.3805
I - 14	5,058.5229	4,968.0787
I - 15	5,049.7954	5,026.9379
I - 16	5,054.2533	5,010.7361
I - 17	5,059.3045	4,996.4105
I - 18	5,066.8174	4,981.5062
I - 19	5,073.7050	4,973.1911
I - 20	5,072.1790	5,032.5670
I - 21	5,074.9400	5,018.3570
I - 22	5,077.6499	5,000.4244
I - 23	5,082.0900	4,983.8046
I - 24	5,087.1410	4,976.2043
I - 25	5,091.2537	5,037.4676
I - 26	5,090.1550	5,020.4814
I - 27	5,096.5125	5,008.2331
I - 28	5,098.5016	4,990.9647
I - 29	5,108.6870	4,971.1868
II - 1	5,103.4396	5,010.1482
II - 2	5,106.9698	5,003.7722
II - 3	5,113.9905	5,026.3999
II - 4	5,123.3563	5,007.8476
II - 5	5,125.7058	4,997.8604
II - 6	5,154.2248	5,007.8975
II - 7	5,149.8078	5,025.0740
II - 8	5,147.4665	5,034.8980
II - 9	5,123.4471	5,044.7804
II - 10	4,998.2248	4,988.9306
II - 11	5,017.2445	4,947.1550
II - 12	4,977.0877	4,968.5328
II - 13	4,990.8134	4,956.5407
II - 14	4,986.1960	4,940.9133
II - 15	4,967.5671	4,988.9789
II - 16	5,202.1863	5,012.1930
II - 17	5,027.3920	4,946.1142
II - 18	5,019.7038	4,928.4987
II - 19	4,970.4226	4,960.4761

LEGEND:

- —TL— TRANSMISSION LINE
- —T— TELEPHONE LINE
- —E— ELECTRICAL LINE
- —W— WATER LINE
- —S— SANITARY LINE
- ==SS== STORM SEWER LINE
- MANHOLE
- CATCH BASIN
- CREOSOTED POLE
- ORNAMENTAL POLE
- LUMINARY
- 50+001 SPOT ELEVATIONS
- B.M. BENCH MARK (SEE NOTE)
- N.S. NOT SAMPLED
- N.D. NOT DETECTED
- M.E. MASKING EFFECT
- D DCE
- T TCE
- P PCE

NOTES:

1- ALL DISTANCES AND ELEVATIONS ARE IN METERS.
2- HORIZONTAL AND VERTICAL CONTROL ARE REFERED TO LOCAL SYSTEM.
3- BENCH MARK - CHISELED TRIANGLE MARK ON MANHOLE FRAME. ELEV. = 50.000 MTS. (ASSUMED).

ELEVATION MEASUREMENT MAP - FIGURE 4.2.1

PREPARED FOR : BELGODERE AND ASSOCIATES, INC.
LOCATION : FOUR WIND PLAZA SHOPPING CENTER STATE ROAD NO. 38 ST. THOMAS, U.S. VIRGIN ISLAND

SURVEY CERTIFICATE:

I DO HEREBY CERTIFY THAT THIS SURVEY WAS MADE DURING THE MONTH OF APRIL 1988, THAT THEODOLITES FOR HIGH ORDER ACCURACY (WILD T-2), AND ELECTRONIC DISTANCE MEASURING INSTRUMENT (WILD DI-3) WERE USED FOLLOWING THE STANDARD SURVEY TECHNIQUES FOR THESE CASES.

PRJ88-22 (500)

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500 BALEARES ST. PUERTO NUEVO P.R., GPO BOX 3763, SAN JUAN PUERTO RICO 00936 - TEL. 783-6325

CERTIFIED BY: DATE:

Kelly Alvarez Perez S.S.L.S. LIC. NUM. 7178

Marcelino Diaz Deciet S.S.L.S. LIC. NUM. 7156

4.3 AREA 2 - Area west and southwest of ETSS facility.

Concentrations of benzene hydrocarbon vapors found in the area west and southwest of the ETSS facility range from ND to 128 ppm. (see figure 4.1.3).

The highest benzene concentration in this area, 128 ppm, was found at station I-10. This station is near a pipeline which once connected the ETSS facility oil/water separator to the Four Winds parking lot storm water drainage. This pipeline was in service for a relative short time before it was disconnected and capped.

4.4 AREA 3 - North and east of ETSS facility.

A third area of measurable aromatic hydrocarbon vapor concentrations ND to 2.5 ppm of benzene, was found to extend to the survey boundaries, 400 ft. to the north and 83 ft. to the east of the ETSS facility. Aromatic hydrocarbon vapor concentrations found in this area are possibly a result of vaporization from hydrocarbons present in regional groundwater which may be attributable to other sources.

It is not possible to ascertain the sources of hydrocarbon vapors found in the area from this soil vapor survey. A more direct method such as borings, monitoring well installations, and sampling and analyses will have to be employed to refine the data base.

5.0 CHLORINATED HYDROCARBON

Table 5.0.1 presents the results of chlorinated hydrocarbon (TCE, PCE & DCE) analyses for each soil vapor sample collected during the survey. Copies of all chromatograms and daily calibration curves are presented in the separate supplement entitled: "Photocopies of Original Gas Chromatograms and Calibration Curves".

Chlorinated hydrocarbons, although not typically found in motor fuel, were analyzed in the soil vapor samples at the request of DPNR-EPA. This request was made because chlorinated hydrocarbons were found in water supply wells in the Tutu area.

The survey results show that the highest chlorinated hydrocarbon (DCE, PCE & TCE) concentrations ranging from ND to 189 ppm were obtained in area 2. Total chlorinated hydrocarbon vapor samples from stations I-4 and II-11 in Area 2 yield values of 78 and 189 ppm, respectively (see figure 5.0.2). In Area 1, seven samples were analyzed for chlorinated hydrocarbon vapors. The values range from ND to a high of 16 ppm of total chlorinated hydrocarbon vapors at Station I-23 located on the northwest corner of the ETSS facility. At Station I-17 chlorinated hydrocarbon vapors were detected but due to the high concentrations of aromatic vapors, quantification of chlorinated vapors was not possible. In Area 3, the highest concentration of total chlorinated hydrocarbon vapors, 13 ppm, was found at Station II-8 located on the edge of the survey northwest boundary. Concentrations of chlorinated hydrocarbon vapors in

Area 3 decrease toward the south. This is evident by values obtained from samples at Stations II-4 and I-28. This suggests that the source of chlorinated hydrocarbon is from an area to the north of the ETSS facility.

TABLE 5.0.I

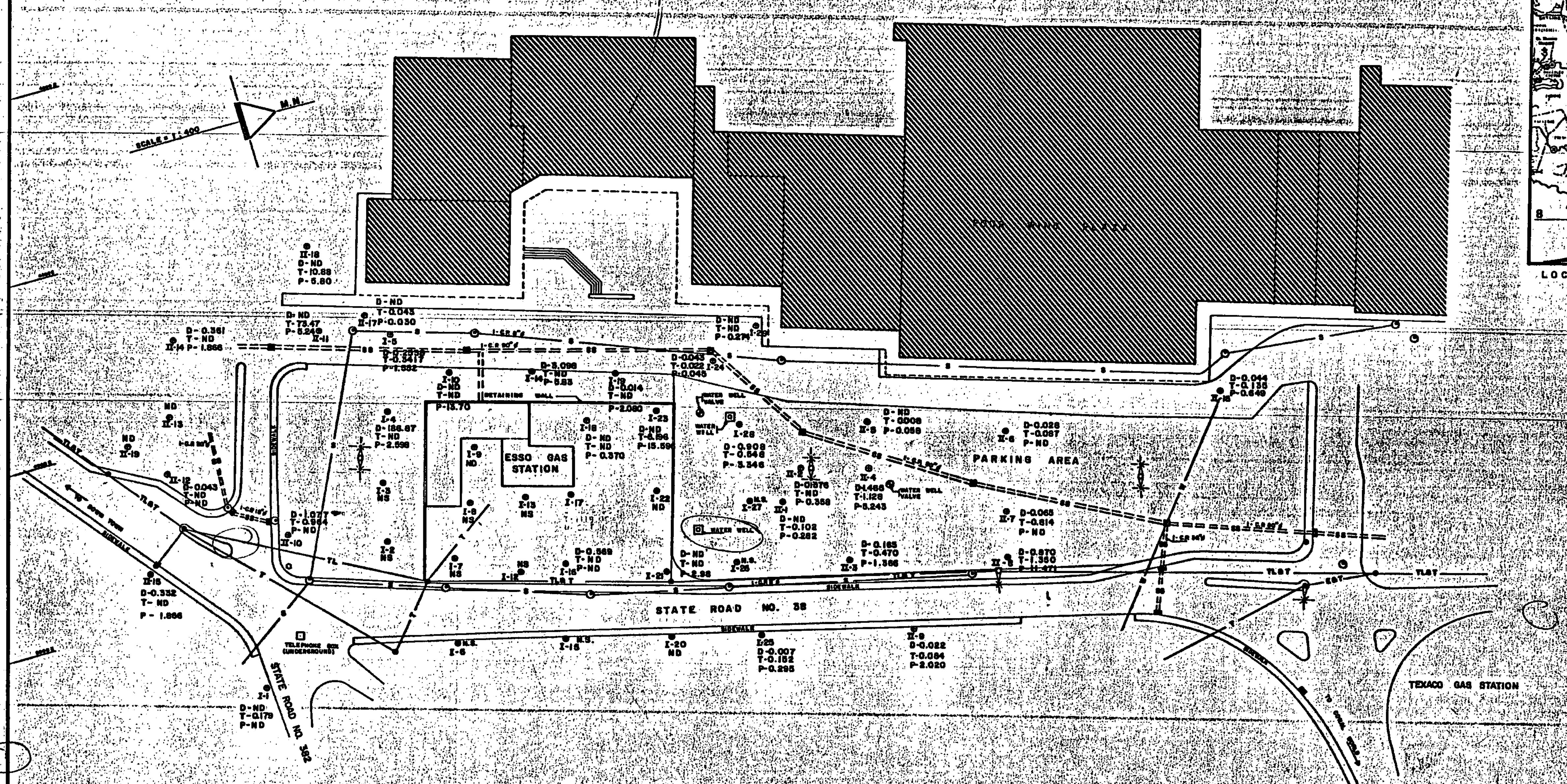
HIGHEST CONCENTRATIONS OF CHLORINATED HYDROCARBON VAPORS FOUND IN SOIL GAS SAMPLES, ESSO TUTU AREA (PPM)

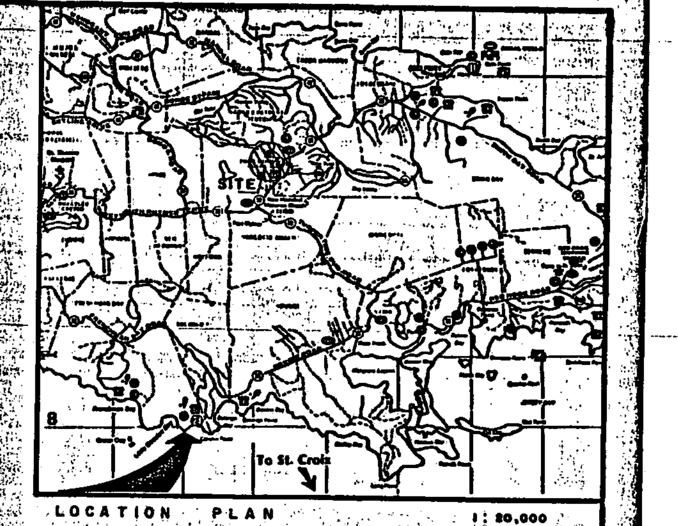
LOCATION	DATE	DCE	TCE	PCE	TOTAL
I-1	APRIL/20	ND	0.179	ND	0.179
I-4	APRIL/22	186.87	ND	2.598	189.468
I-5	APRIL/20	0.2538	0.3417	1.552	2.148
I-9	APRIL/11	ND	ND	ND	ND
I-10	APRIL/11	ND	ND	13.70	13.70
I-14	APRIL/11	3.098	ND	5.83	8.928
I-16	APRIL/23	0.569	ND	ND	0.569
I-17	APRIL/22	ME	ME	ME	ME
I-18	APRIL/12	ND	ND	0.370	0.370
I-19	APRIL/11	0.014	ND	2.08	2.094
I-20	APRIL/16	ND	ND	ND	ND
I-21	APRIL/12	ND	ND	2.98	2.98
I-22	APRIL/12	ND	ND	ND	ND
I-23	APRIL/12	ND	6.196	15.596	21.792
I-24	APRIL/14	0.043	0.022	0.045	0.110
I-25	APRIL/28	0.007	0.152	0.295	0.454
I-28	APRIL/13	0.908	0.548	3.346	4.802
I-29	APRIL/13	ND	ND	0.274	0.274

LOCATION	DATE	DCE	TCE	PCE	TOTAL
II-1	APRIL/16	0.180	ND	0.102	0.282
II-2	APRIL/16	0.376	ND	0.358	0.734
II-3	APRIL/16	0.165	0.470	1.366	2.001
II-4	APRIL/18	1.465	1.128	5.243	7.836
II-5	APRIL/19	ND	0.008	0.058	0.066
II-6	APRIL/19	0.028	0.087	ND	0.115
II-7	APRIL/19	0.065	0.814	ND	0.879
II-8	APRIL/19	0.870	1.350	11.471	13.691
II-9	APRIL/19	0.022	0.084	2.02	2.126
II-10	APRIL/28	1.077	0.964	ND	2.041
II-11	APRIL/21	ND	73.47	5.24	78.71
II-12	APRIL/21	0.043	ND	ND	0.043
II-13	APRIL/21	ND	ND	ND	ND
II-14	APRIL/21	0.361	ND	1.866	2.227
II-15	APRIL/21	0.332	ND	1.866	2.198
II-16	APRIL/22	0.044	0.135	0.649	0.828
II-17	APRIL/22	ND	0.043	0.030	0.073
II-18	APRIL/22	ND	10.88	5.80	16.68
II-19	APRIL/23	ND	ND	ND	ND

ND-NOT DETECTED

ME-MASKING EFFECT





LOCATION PLAN 1: 20,000

BORING	COORDINATES Y	COORDINATES X
I - 1	4,984.7068	5,020.4167
I - 2	5,018.5645	4,996.1435
I - 3	5,021.1871	4,983.2743
I - 4	5,026.2624	4,968.4895
I - 5	5,031.3505	4,982.1880
I - 6	5,027.3851	5,021.9095
I - 7	5,031.6320	5,003.6019
I - 8	5,038.4968	4,992.5085
I - 9	5,042.2215	4,981.0661
I - 10	5,041.4618	4,963.7731
I - 11	N.S.	N.S.
I - 12	5,044.4321	5,010.1316
I - 13	5,049.8873	4,994.3808
I - 14	5,058.5229	4,968.0787
I - 15	5,049.7954	5,026.9379
I - 16	5,054.2533	5,010.7381
I - 17	5,059.3043	4,996.4106
I - 18	5,066.8174	4,981.5062
I - 19	5,075.7050	4,975.1911
I - 20	5,072.1790	5,032.5670
I - 21	5,074.9400	5,018.3570
I - 22	5,077.6499	5,000.4244
I - 23	5,082.0900	4,983.6046
I - 24	5,097.1410	4,976.2843
I - 25	5,091.2537	5,037.4678
I - 26	5,090.1650	5,020.4814
I - 27	5,096.5125	5,008.2531
I - 28	5,098.5016	4,990.9647
I - 29	5,108.6878	4,971.1868
II - 1	5,103.4396	5,010.1482
II - 2	5,108.9698	5,003.7722
II - 3	5,113.9906	5,026.3899
II - 4	5,123.3563	5007.8476
II - 5	5,125.7058	4,997.8604
II - 6	5,154.2248	5,007.8975
II - 7	5,149.8076	5025.0740
II - 8	5,147.4665	5,034.8980
II - 9	5,123.4471	5,044.7804
II - 10	4,998.2248	4,988.9306
II - 11	5,017.2445	4,947.1530
II - 12	4,977.0877	4,969.5328
II - 13	4,980.8134	4,956.5407
II - 14	4,986.1960	4,940.5133
II - 15	4,967.5671	4,988.9789
II - 16	5,202.1863	5,012.1930
II - 17	5,027.3920	4,946.1142
II - 18	5,019.7038	4,928.4987
II - 19	4,970.4226	4,960.4781

OVIHA
LAGA

LEGEND:

—TL—	TRANSMISSION LINE
—T—	TELEPHONE LINE
—E—	ELECTRICAL LINE
—W—	WATER LINE
—S—	SANITARY LINE
==SS==	STORM SEWER LINE
	MANHOLE
	CATCH BASIN
	CREOSOTED POLE
	ORNAMENTAL POLE
	LUMINARY
50+001	SPOT ELEVATIONS
B.M.	BENCH MARK (SEE NOTE)
N.S.	NOT SAMPLED
N.D.	NOT DETECTED
M.E.	MASKING EFFECT
D	DCE
T	TCE
P	PCE

NOTES:

1- ALL DISTANCES AND ELEVATIONS ARE IN METERS.
2- HORIZONTAL AND VERTICAL CONTROL ARE REFERED TO LOCAL SYSTEM.
3- BENCH MARK- CHISELED TRIANGLE MARK ON MANHOLE FRAME. ELEV. = 50.000 MTS. (ASSUMED).

DISTRIBUTION MAP OF CHLORINATED HYDROCARBONS (PPM) FIGURE 5.0.2

PREPARED FOR : BELGODERE AND ASSOCIATES, INC.
LOCATION : FOUR WIND PLAZA SHOPPING CENTER STATE ROAD NO. 38 ST. THOMAS, U.S. VIRGIN ISLAND

SURVEY CERTIFICATE:

I DO HEREBY CERTIFY THAT THIS SURVEY WAS MADE DURING THE MONTH OF APRIL 1988, THAT THEODOLITES FOR HIGH ORDER ACCURACY (WILD T-2), AND ELECTRONIC DISTANCE MEASURING INSTRUMENT (WILD DI-3) WERE USED FOLLOWING THE STANDARD SURVEY TECHNIQUES FOR THESE CASES.

PRJ88-22 (500)

KELLY ALVAREZ PEREZ AGRIMENSOR LICENCIADO LIC. 7176 PUERTO RICO

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CERTIFIED BY: DATE: 6 - 01 - 1988

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6.0 Recommendations

The results of the soil vapor survey have indicated that detectable levels of both aromatic and chlorinated hydrocarbon vapors are present in the subsurface. However, it was not possible to ascertain the sources of these vapors, nor the actual concentrations that may be present as dissolved constituents in the local groundwater. To refine the existing data base, a more direct methodology of sampling and analyses must be employed. The following recommendations are submitted for your consideration to achieve the desired results.

A subsurface investigation is recommended to be undertaken consisting of drilling, well installation, and soil and water sample collection and analyses. The actual boring locations will be based on field conditions and site accessibility. Borings should be completed as monitoring wells to collect water level elevation data, and water samples for chemical analyses.

During the drilling, the soil cuttings should be scanned with a portable photo-ionization detection (PID) meter to determine the concentration of volatile organic vapors. The PID readings may provide some indications of preferred zones of hydrocarbon movement.

At the completion of the well installation program, the top of the casings should be surveyed to a common datum. Additionally, the elevations of the nearby existing water supply

wells should be surveyed. Water level elevations will be measured and the general direction of horizontal groundwater flow can be established.

The proposed new wells, and the nearby existing water supply wells should be sampled, and the water analyzed for selected dissolved constituents. To aid in the interpretation of the data, and assess the suitability of samples collected from the water supply wells with the use of the existing pumping equipment, as much information as possible should be collected and reviewed. Data such as: construction details, lithologic logs, pump setting, pumping rates, water-level measurements, and water-sample analyses should be collected and reviewed.

Because the underground storage tanks at the ETSS are to be replaced as part of the planned ESSO Service Station Upgrading Program, some additional tasks should be undertaken during this activity. During the excavation, observations should be made to determine the presence of free product in the existing tank field. In the event that free product is found during the tank excavation activity, product should then be immediately removed and disposed of properly. Additionally, any soil or backfill material excavated should be scanned with a portable PID meter for the presence of volatile organic vapors. Should the presence of volatile organic vapors be indicated by the PID readings, soil samples should be collected for laboratory analyses.

It is further recommended that commencement of the above recommendations be undertaken as soon as possible. This will allow ESSO to develop a better understanding of the nature and extent of the situation, and to further respond to any potential problem in an expeditious manner.

APPENDIX A

OPERATIONAL PROCEDURES AUDIT
SOIL VAPOR INVESTIGATION

ESSO - TUTU SERVICE STATION
ST. THOMAS, USVI

BY:
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OPERATIONAL PROCEDURES AUDIT
SOIL VAPOR INVESTIGATION
ESSO - TUTU SERVICE STATION
ST. THOMAS, USVI

INTRODUCTION

The audit to the Soil Vapor Investigation conducted by Belgodere & Associates Inc. (BAI), at the ESSO - TUTU Service Station was performed by Sharetech - Omar Muñiz & Associates. The Quality Assurance (QA) Officer, Eng. Omar Muñiz, was assisted by Mr. Julio Rodriguez and Mr. Jose G. Vila. Sharetech conducted a continuous field system and operational procedures check. Mr. Jose G. Vila was present during the complete project from April 5, 1988 to April 23, 1988. Observations and recommendations were brought to the attention and discussed with BAI personnel during this period. This report is a summary of said information.

PURPOSE OF THE AUDIT

The audit was conducted to verify that the procedures described in the Work Plan and in the QA/QC Plan were being followed. The auditor was present for any consulting to the Project Officer or any member from his staff in relation to necessary modifications based on the experience in the field. The main purpose is to keep or improve the final work product.

FIELD OBSERVATIONS

Based on field judgments and/or mutually agreed decisions, some changes were necessary during the project. These were necessary due to field and specific site conditions. There were electrical voltage variations and intermittent power failures, which caused some unexpected delays. Additional field equipment was brought into the operation to solve this problem. Among these were an auxiliary power plant and electric current rectifier.

One of the two Gas Chromatographs (CG) was equipped with a PID detector. At the end of the first week of the project, and by request of CDM, the amount of sample to be injected into the GC was increased. Upon increasing the sample injection the detector started to malfunction and to show no or very poor resolution. The peaks of concern did not appear. The most probable causes for these conditions are that the PID detectors were affected by humidity, electrical variations, as well as the increased sample injection. After the PID detector was rendered inoperative, its use was discontinued for the rest of the project.

In order to check on the validity of the FID detector, standard samples were injected to verify the resolution. After few injections and the adjustments to the instrument conditions, all the parameters of concern were clearly recognized. The samples of the first week were qualitatively analyzed. The quantification of these samples was performed afterwards.

The sampling procedures were followed as described in the plan with minor changes. The depths from which samples were collected were changed in those situations where subsurface conditions did not allow penetration to the target depth. CDM representatives suggested that the minimum depth for vapor sampling be established at two feet below surface. In addition, a minimum depth separation of two feet must be maintained between sample collection at the same station. This sampling procedure was mutually agreed. A total of sixty-two (62) samples were collected during the investigation.

At the beginning of field activities and at the request of EPA-CDM, the original sampling pump was replaced with a pump having an indicating flow device and a higher capacity. The new pump was calibrated before its use and checked again at the end of the project. Pump calibration did not vary more than one percent.

Internal quality control checks such as field blanks, syringe blanks and equipment blanks were conducted during the project. Three point calibration samples were processed and plotted at a latter date. Although the work plan originally considered the taking of duplicate samples at each sampling point, two independent samples were taken in sequence. The method of taking the samples did not allow for replicate samples because of the dynamic conditions of the source where samples were taken.

DEVIATIONS FROM WRITTEN PLAN

	DEVIATION	QA/QC SECTION	PLAN PAGE
A.	All samples were not field tested for Total Hydrocarbons, Benzene, Toluene, Ethylbenzene, Xylene, Trichloroethylene, Tetrachloroethylene and Dichloroethylene.	2.3	2
B.	Other GC columns were used.	2.3	3
C.	Samples were injected to the GC using the same gas tight glass syringe in which samples were collected.	4.0	7
D.	During the first week of work one point calibration checks were conducted.	6.0	11
E.	The Photo Ionization Detector was eliminated at the beginning of the investigation.	2.3	3
F.	Calibration checks did not necessarily follow after each five samples sequence.	6.0	11
G.	The standard for 100 PPM of BTEX was not available at the start of the investigation.	8.2	13

RECOMMENDATIONS

The results for each day of work should be reported to include the calibration curve with the respective chromatograms and the chromatograms of each of the samples. All the deviations mentioned before should be explained in the final report. It is highly recommended that the Project Manager include all the statistical analyses and criteria used for data validation and the use and limitations of the results obtained as applicable.